separated in regard to animal distribution. This latter point goes far toward being the sole cause of regions. Any large mass of land separated from the rest of the world will, in the course of time, become inhabited by a peculiar set of animals, and obtain a comparative balance or stability of life. Thus a number of species are evolved which forms a sort of compound whole, — the life of a region. So a region may be defined as the area occupied by a peculiar grouping of animals which are isolated from the life of the rest of the world; the word 'peculiar' referring to the animals as a whole, and the isolation as of a limited and not absolute degree.

Accepting the above definition, the world can be conceived of as divided into regions, which, if the land and sea remained at rest, would be permanent, but constantly growing more and more distinct. But the land is not permanent. While the main mass is a fixture, minor changes occur, which join and separate the continents. As soon as two lands are joined, unless some other very powerful barrier exists, the life of the two at once begins to blend. The more potent kinds survive, while the weaker die out. The first, together with the life modified by the new conditions (new species evolved), in the course of time form a single region. On the other hand, if a land become divided into two, the reverse takes place, and two regions are formed. To me the palearctic and nearctic regions seem to offer illustrations of both these processes; the connection for life having been made and broken between the old and new worlds, probably by means of Asia, more than once. At present it is broken; and the nearctic and palearctic regions are formed or forming from a previous circumpolar region. With the tentative definition given here, the two are regions, since they do not form a group, and are separated. No lack of percentage differences can make the life of the two regions closely related: a change in one does not necessitate a change in the other. This also answers the circumpolar question: the resemblance in zones is due, first, to the imperfect obliteration of the old circumpolar region; and, secondly, to the fact that some of the forms which inhabited it have been driven down into the southward-pointing peninsulas, where the conditions of their life are easier. According to this definition, Madagascar should be regarded as the remains of a fading region, rather than a part of the Ethiopian. The resemblance between Africa and India is due to a southward migration which occurred not so long ago, very likely on account of the ice age, from a northern central point.

The above crude suggestions would seem sufficient to show that regions are more than numerical relations, and have an evolution of their own.

J. AMORY JEFFRIES.

Panther Creek coal-basin.

I have just read your review of the Panther Creek atlas, in SCIENCE, No. 11, and my attention has been directed to what I consider a very just and proper criticism of two special features of the atlas sheets: 1°. The discordant scales of the mine (800′=1″) and topographical (1600′ = 1″) sheets. 2°. The use of the magnetic instead of the true meridian. As a geological critic, I should be disposed to boldly condemn what you have referred to as merely misfortunes. After an association of nine years with Professor Lesley on the Pennsylvania state survey, I am convinced, that, in the successful conduct of such a survey, it is quite impracticable to attempt to attain a purely technical and systematic standard of work. All that can be done is to approach as near as possible to such a standard, while meeting the practical demands for geological results, to aid in the economical exploitation of our mineral resources. This latter is what has popularized the work of the Pennsylvania survey, and accounts for its uninterrupted continuance with liberal appropriations for a state survey, since 1874.

The published results of the survey so far relate mostly to topographical, geotectonic, and stratigraphical geology in their economical bearings, with the exception of two volumes on paleobotany. Had any other plan than that of Professor Lesley's, which he has so efficiently carried out, been instituted, the survey would never have been so liberally supported by our state legislature, and probably would have been discontinued several years ago. The important thing in a state survey is to do the best we can. If we attempt too much, we fail in all.

In regard to the discordant scales and magnetic meridian, I would say: 1°. That the publication committee of the board of commissioners has never before authorized the printing of *general maps* on a scale larger than 1600′=1″. This scale was found quite too small for the anthracite-mine sheets, and it was only after the most careful consideration on the part of the committee that a scale of 800′=1″ was adopted for the mine sheets. The smaller scale was unfortunately adhered to for the topographical sheets, on account of the cost of publication. 2°. In the Panther Creek basin, the magnetic meridian of 1869 is always used in all surveys; and the block-lines referred to this meridian on the atlas sheets have been similarly placed on all the large working mine maps. In this form the sheets are of much greater practical value for ready reference. Had the publication of this atlas been delayed until the completion of the astronomical determinations of the survey in this locality, we should probably not have obtained an additional appropriation to continue the survey, which we now feel assured of receiving.

CHARLES A. ASHBURNER,
Geologist in charge.

Philadelphia, April 21, 1883.

Crayfish.

In August, 1882, while in Fairmount Park, Philadelphia, I found a crayfish in a brook emptying into the Wissahickon Creek. It had its under parts covered with young crayfish about one-eighth of an inch long.

Professor Huxley says that the English species, Astacus fluviatilis, lays eggs in May and June, and the young leave the female in a few days; but the young staid ten days with the female after I found them. There seems to be a difference in their habits in this respect. Last Friday, April 6, I found a female crayfish with young ones clinging to it, which I caught; and a friend now has it in a tank. Do crayfish lay eggs both early in the spring and late in the summer?

RICHARD M. ABBOTT.

Trenton, N.J.

[The writer of the above is eleven years of age. — ED.]

Marking geodetic stations.

The writer of the article in SCIENCE of April 13, 1883, p. 269, in referring to the method of marking the geodetic stations in the N. Y. state survey, makes the statement that the U. S. coast survey stations are indicated 'by no surface-mark whatever,' trusting entirely to the underground-mark for the preservation of the station. The writer has, doubtless, been misled by visiting a station from which the surface-marks have been removed by curious or malicious persons. In the coast survey the greatest stress is

laid upon the importance of carefully marking stations; and the detailed instructions in regard to the subject occupy two quarto pages in the manual 'On the field-work of triangulation,' issued by the survey. The most common method used is the one which has been copied by the N. Y. state survey. Other methods, however, are used in special cases. For recovering a station, the main dependence is upon the surface-marks, and the underground-marks are used only for protection in case of the destruction of the others by accident or design.

H. W. BLAIR,
Assistant Coast and geodetic survey.

Washington, D. C.,
April 22, 1883.

Freezing of liquids in living vegetable tissue.

The conclusions of Mr. Meehan in relation to the above topic (SCIENCE, p. 229) seem to me scarcely warranted by the best authenticated facts in vegetable physiology. Experimental investigations and researches, undertaken many years ago, led me to the following deductions:[1] —

1. That the sap of many living plants can be frozen by the application of a degree of cold not much below that required to freeze it when removed from the plant; and that in very cold climates the sap of all perennial plants must be frozen in all parts during the winter months.

2. That the congelation of the juices of living vegetables does not, as many phytologists have imagined, necessarily and inevitably result in the death of the whole plant, or of the part in which it takes place, but, on the contrary, that frequently no injurious consequences follow. Consequently it is unwarrantable to assume that a plant which is not killed by severe cold never was frozen; and therefore it is unnecessary to invoke the aid of a 'vital power' to enable plants to survive the influence of cold sufficiently intense to freeze their juices when removed from the living plant.

3. That the bursting of the trunks of trees in high latitudes is not due to the expansion which the sap undergoes in process of congelation, but to the unequal contraction which takes place in the trunk (usually after the complete congelation of its juices) in consequence of a sudden depression of temperature. In short, that the rupture of the trunk in such cases is due to the same cause as the rents in the frozen ground, and the cracks in large sheets of thick ice, which occur in high latitudes when there is sudden accession of cold. This view is fortified by the fact that the coefficient of contraction (or expansion) of ice is greater than that of any other solid body hitherto examined, with the exception of hardened caoutchouc, or ebonite.

JOHN LECONTE.

Berkeley, Cal., April 17, 1883.

Sun's radiation and geological climate.

In his review of Whitney's climatic changes, Mr. Gilbert says, "His [Whitney's] hypothesis that the intensity of solar radiation is gradually lessening, by reason of the dissipation of solar energy, . . . will be admitted by most students." Mr. Whitney and his reviewer fall into the very natural error, that a loss of heat, and, of course, of energy, is *necessarily* accompanied by a fall in temperature. Paradoxical as it may appear, a loss of both heat and energy may produce a rise in the temperature of the body that loses them. If it be true that the sun is, as is now thought by many eminent scientists, a globe of gaseous matter, then, under the long process of giving off heat, it has actually been growing hotter, and the intensity of its heat on the earth's surface to-day is greater than it was in the early geological epochs.

The world is indebted for this curious fact to Mr. J. Homer Lane.[1] I quote from Newcomb's Astronomy, p. 508: "The principle in question may be readily shown in the following way: if a globular, gaseous mass is condensed to one-half its primitive diameter, the central attraction upon any part of its mass will be increased fourfold, while the surface upon which this attraction is exercised will be reduced to one-fourth. Hence the pressure per unit of surface will be increased sixteen times, while the density will be increased only eight times. Hence, if the elastic and gravitating forces were in equilibrium in the primitive condition of the mass, its temperature must be doubled in order that they may still be in equilibrium after the diameter is reduced one-half."

Admitting, then, the gaseous condition of the sun, as, under our present knowledge, we seem compelled to do, we must also admit that the intensity of the sun's radiation of heat has been slowly increasing through the ages, and to-day is greater than at any previous time. The increase may have been small; but, so far as there has been any change, it has been in the direction of an increase, and hence cannot explain the undoubted decrease in the general temperature of the earth's atmosphere indicated by the paleontological record.

C. B. WARRING.

Distribution of public documents.

Few outside of the ranks of professional politicians will disagree with the report of the committee of Congress on the printing and distribution of public documents, or with the tenor of the editorial remarks on the subject in No. 9 of SCIENCE. But it is to be feared that it will be as difficult to induce the average congressman to dispense with these lubricants of the political machine as with the senseless distribution, through the department of agriculture, of seeds that can as well be bought at any country store. If any means can be devised by which the 'costly and beautifully illustrated volumes' shall reach those for whose information they were written, instead of serving to adorn the nurseries of influential ward strikers and campaign committee men, it will redound greatly to the benefit of scientific knowledge and progress; for at present it is mainly through the medium of second-hand book-stands that those interested can occasionally get the professional works of which their political insignificance did not render them worthy recipients.

There is one notable exception, however, to this extravagance and misdirection of precious documents, the result of one of those spasms of virtue mentioned in the editorial. I refer to the law concerning the distribution of the publications of the geological survey, to which director Powell has called attention in a circular issued some time ago. According to the terms of this law, these documents, excepting the general report, can be obtained only by purchase or exchange; that is, the scientific workers of the country may at first get what may be deemed the equivalent of their own publications, or, possibly, of rare works in their possession. But when this resource is exhausted, the only method open to them, for obtaining what in many cases is the sequel of

[1] For the exposition of the basis of these deductions, the reader is referred to the memoir of the writer, entitled "Observations on the freezing of vegetables, and on the causes which enable some plants to endure the action of extreme cold."—(*Proc. Amer. assoc. adv. sc.*, vi. 338-359; *Amer. journ. sc.* [2], xiii. 84-92, 195-206.)

[1] See *Amer. journ. sc.*, July, 1870.